U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-255 160

USPHS SURVEY OF COMMUNITY WATER SUPPLIES

Bureau of Water Hygiene

23 June 1970

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PB 255 160

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USPHS SURVEY OF COMMUNITY WATER SUPPLIES

by

L. J. McCabe
Director
Division of Epidemiology and Biometrics
Bureau of Water Hygiene

Presented at

American Water Works Association
90th Annual Conference
June 23, 1970

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-255 160
4. Title and Subtitle USPHS Survey of Community Water Supplies.			5. Report Date June 23, 1970 6.
7. Author(s) L. J. McCabe			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Bureau of Water Hygiene Rockville, Maryland Department of Epidemiology and Biometrics			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered 14.

15. Supplementary Notes Presented at American Water Works Association 90th Annual Conference on June 23, 1970.

16. Abstracts

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17. Key Words and Document Analysis. 17a. Descriptors

*Water supply
*Water pollution
*Water quality
Potable water
Standards
Public health

17b. Identifiers/Open-Ended Terms

Water quality standards

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
National Technical Information Service Springfield, VA 22161	UNCLASSIFIED	24
	20. Security Class (This Page) UNCLASSIFIED	22. Price PC$3.50/ MF$2.25

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

This Study stems from a need to know what the Public Health Service should be doing in the area of water supply to protect America's health. We all know that water-borne disease used to be a terrible problem, but this seems to be long ago. There are, of course, still a few water-borne disease outbreaks.

About 12 in 1969
(Holy Cross was most publicized)

Emphasis on water pollution - Is there health surveillance of drinking water? The Public Health Service keeps tab on about 700 water supplies that are Interstate Carrier Supplies. But this is not intensive and lacks chemical results particularly.

The current study set out to find if the American consumers' water met drinking water "Standards". The emphasis is on water quality, but the DWS more than set limits, other requirements to assure reliability.

I must apologize to any utility that was included as well as to the state health departments that were involved. I don't think the unsampled supplies are any different, but due to the nature of our society and the interest in NEWS-worthy items. If you were included you have taken a lot of lumps and will continue to get them until the report is out of print.

I got involved in December 1968 - remember the legislation talked about at the Cleveland meeting? I would liked to have surveyed more supplies more extensively, but wanted to complete the Study in about a year - and we did all we could do with our staff. About 65 worked on the study, some at different phases - so our regular work could continue.

Our samples were selected by Metropolitan areas. There were 231 of these - set by Census, Federal agencies tabulated data by these and as epidemiologist, I favored this sample --

> A city of 50,000 and its county and the surrounding counties that are metropolitan in character.

We selected nine of the SMSAs -- One in each region so each Regional Representative could lead a field investigation. We had knowledge of the larger supplies and selected to have a diversity of water supply practices.

The samples contained 33 of the Interstate Carrier Water Supplies; 18% were on Provisional status. If you read McCall's or the Saturday Review, you know this is about an average.

SLIDE 1.

COMMUNITY WATER SUPPLY STUDY

SUPPLIES IN STUDY

	TOTAL	100,000 OR MORE POPULATION SERVED
VERMONT STATE	218	0
NEW YORK SMSA	221	10
CHARLESTON, W. VA.	30	1
CHARLESTON, S. C.	22	1
CINCINNATI, OH, KY, IND.	66	2
KANSAS CITY, KAN, MO.	88	4
NEW ORLEANS, LA.	26	3
PUEBLO, COLO.	20	1
SAN BERNARDINO, RIVERSIDE, CALIF.	278	2
	969	24

SLIDE 1.

Our regional people did not all have the same work-load.

The New York City supply was the largest, but Everett MacLeman also had 220 other supplies to study. The city supply is an upland watershed, but the supplies on Long Island use ground-water.

The largest area was the San Bernardino and Riverside County areas in California. This had the most supplies - 278 but only 2 served 100,000 or over-mineralized ground-water [illegible]. Francis Nelson lead the field work and will be our Regional Representative in the new office, Region X in Seattle.

Floyd Taylor did things his way and obtained a request from the Governor and got the original selected area changed to include the entire state of Vermont. There are many small springs and other rudimentary arrangements made to obtain water in Vermont.

We did the two Charleston's. Ed Lippy lead the field work in West Virginia and Gary Hutchinson in South Carolina.

Don Marshall of the Chicago office headed up the field work in the Cincinnati SMSA which includes parts of Ohio, Kentucky and Indiana. The larger supplies use water from the Ohio River but the smaller supplies usually use ground-water.

We started in Cincinnati in February 1969 and worked out protocol and data gathering forms problems where we have our research offices.

The Kansas City SMSA had the larger supplies served by surface water but here some of the smaller supplies are also using surface water. Ted Ferris lead the work in Missouri and Kansas.

New Orleans is at the end of the midwest drainage with several large supplies using Mississippi river water. Chuck Northington of Dallas was in charge.

Al Soukup of the Denver Office had the fewest supplies to study and came up with some of the most unique waters at Pueblo, Colorado.

We studied all supplies with a resident population served of 25 or more. Supplies for tourist accomodations and institutions were tabulated separately as the administration of these supplies is often handled differently by state health departments.

Of the 969 supplies studied, 84 were these special public water supplies.

We collected samples from each supply for analyses in our laboratories or the PHS radiological labs. For time con-

suming analyses and constituents not likely to change in distribution we collected samples at the wells or treatment plants, 2-week composits if possible. Trace metals and bacteriology were run on distribution samples -- 10% of the number required by the DWS per month with the same minimum of two.

We have a report under review and hope it will be out in a few weeks but I will give you the highlights:

SLIDE 2.

COMMUNITY WATER SUPPLY STUDY

QUALITY OF DRINKING WATER

	PERCENT OF SYSTEMS		
	LESS THAN 500 SERVED (446)	GREATER THAN 500 SERVED (523)	ALL SYSTEMS (969)
MET STANDARDS	50	67	59
EXCEED RECOMMENDED	50	33	41
EXCEED MANDATORY	24	10	16

SLIDE 2.

Overall, 59% of the systems met the Standards, but based on average water quality, 41% exceeded the Recommended Standards. (A more suitable supply or treatment should be sought)

16% of the supplies exceeded the Mandatory Standards. (These should be evaluated by the appropriate health authority because water of this quality represents a potential hazard to the health of comsumers.)

The slide shows the results by size of system. About half of the supplies serve less than 500 population. For the smaller supplies 24% exceed the mandatory; while supplies serving over 500 - 10% exceed the mandatory.

None of the largest supplies (>100,000) exceed the mandatory standard on average concentrations. (27% exceed recommended).

SLIDE 3.

COMMUNITY WATER SUPPLY STUDY

SYSTEMS EXCEEDING LIMITS

RECOMMENDED	NUMBER OF SYSTEMS ON AVERAGE EXCEEDING LIMIT	MANDATORY	NUMBER OF SYSTEMS ON AVERAGE EXCEEDING LIMIT
IRON	96	COLIFORM ORGANISMS	120
TOTAL DISSOLVED SOLIDS	95	FLUORIDE	24
MANGANESE	90	LEAD	14
FLUORIDE	52		
SULFATE	25		
NITRATE	17		

FROM A TOTAL OF 969 SYSTEMS

SLIDE 3

This slide shows the major quality problems. Ninety systems or more hand Iron, Dissolved Solids, or Managanese problems. Fifty-two systems exceeded the recommended Fluoride level -- Optimum concentration; 813 not enough, 104 with acceptable range. Seventeen supplies with too much nitrate.

For the mandatory standards, the coliforms were the biggest problem with 120 supplies exceeding the limits. There are more details to follow --

24 supplies had even higher fluoride concentration and exceeded the mandatory limit.

Lead is the most prevalent toxic trace metal problem with 14 supplies exceeding on average.

SLIDE 4.

WATER SUPPLY SYSTEMS IN VARIOUS POPULATION SIZES WHOSE DELIVERED WATER EXCEEDED THE COLIFORM DENSITY LIMIT

Population Range	Number of Systems	Number of Systems Exceeding	Percent Exceeding
≤500	446	79	18
500-5,000	315	29	10
5,000-10,000	75	5	7
10,000-25,000	59	5	9
25,000-50,000	36	1	3
50,000-100,000	16	1	6
>100,000	22	0	0
Totals	969	120	12

SLIDE 4

As the bacteriology was the biggest problem we will give more details on it. The smaller supplies have the greatest problem and it seems to decline with size of system.

Type of source also makes a difference.

37% of spring source

16% of surface and mixed

8% of well sources

but even 5% of supplies buying finished water to distribute

8% of the special public water supplies

Geographic location also makes a difference, but this related to source type

Vermont	29%
Pueblo Area	20%
Southern California Area	11%
Kansas City Area	9%

But perfection can be achieved as we did not find a coliform in the New Orleans area and no supply exceeded the bacteriological limits in the Cincinnati Area.

The Drinking Water Standards are more than a set of limits. Systems must have adequate facilities and be properly operated to assure the public of a safe, continuous supply of drinking water. Some systems are complex and would have many items to pick at, but we have four general areas that can be

considered to present a major deficiency.

SLIDE 5.

Less than half of the supplies had no major deficiencies. These problems can be seen to be more prevalent in the smaller supplies. For the largest supplies (>100,000) 64% had no major deficiencies.

Maintaining pressure (20 psi) in all parts of the system was the most prevalent deficiency. You all know of AWWA interest in cross-connection control and their attempt to stimulate interest in this program. There are few adequate cross-connection control programs (only 13% within the study) and with low pressure you are asking for trouble. No supply can maintain the integrity of its system with a negative pressure.

The next two major deficiencies must be considered together. If you do not have adequate source protection, you must have adequate disinfection facilities and disinfection control. Combined, 38% had these deficiencies.

Not all systems need to or practice clarification by settling and/or filtration but over-all 9% had this deficiency, either in facilities or control of process.

COMMUNITY WATER SUPPLY STUDY

SYSTEM FACILITIES AND CONTROL

PERCENT OF SYSTEMS

	LESS THAN 500 SERVED (446)		GREATER THAN 500 SERVED (523)		ALL SYSTEMS (969)	
NO MAJOR DEFICIENCIES	39		48		44	
DEFICIENCIES						
PRESSURE	32		20		26	
SOURCE PROTECTION	27	42	12	34	19	38
DISINFECTION	15		22		19	
CLARIFICATION	4		13		9	
PERCENT PRACTICING	7	25		17		

SLIDE 5

The third item of evaluation was on the classical public health bacteriological surveillance program. Are there enough samples run and do they indicate a history of good quality?

All utilities should have a concern with quality control but in many cases this bacteriological surveillance is a function of the health department.

SLIDE 6.

COMMUNITY WATER SUPPLY STUDY

BACTERIOLOGICAL SURVEILLANCE PROGRAMS

PERCENT OF SYSTEMS

	LESS THAN 500 SERVED (446)	GREATER THAN 500 SERVED (523)	ALL SYSTEMS (969)
MET CRITERIA	4	16	10
DID NOT MEET	96	84	90
NOT 1/2 ENOUGH	83	57	69

SLIDE 6

Only 10% of the systems met our Study criteria. The size effect can also be seen here. For the largest supplies it was 36% that met criteria.

Overall, 90% of the systems did not take enough samples for more than one month in the last year of record or they did not meet the bacteriological standards.

We know that there are arguments about the number of samples needed to do adequate surveillance so we look at just taking 1/2 enough, that would be just 1 sample a month for the small supplies. It looks better, but not much.

Utility people or health departments staff must think of water systems. Each one is different and has its own problems, and each one must be adequate because it serves some of the public. Also, we travel around a lot and may want a drink of water in some out-of-the-way place.

As an epidemiologist, I can look at the population exposed to our drinking water. We collected about 2600 samples from consumers' taps. Each of these represent the drinking water of a portion of population served. 17% of these samples exceeded one or more of the mandatory drinking water standards.

SLIDE 7.

PERCENT OF INDIVIDUAL DISTRIBUTION SAMPLES EXCEEDING

DRINKING WATER STANDARD LIMITS

	Percent of Samples Exceeding	Percent of Population Served
At least one limit	36	16
At least one Mandatory limit	17	5
Coliform limit	9	2

Based on: 2595 distribution samples and 18.2 million people

SLIDE 7

You can see from the slide that this represents 5% of the population. You can take comfort from this statistic, if you want to, only 5% (10×10^6) of the population are drinking water that is not fit to drink.

But does the system that you are responsible for measure up; can it always deliver a good quality drinking water?

SLIDES OFF.

Why do we have these problems? Elwood Bean's report seems to have the key. Lack of interest in Quality Control? (Only 36% surveyed in the last three years).

Maybe the hydraulic engineers are just interested in pumping something. There seems to be problems here. Also many supplies lack data on production and yields with no plans for meeting future demands.

It may be that operators just don't know what a well operated system should be like.

61% no training at short school level or higher
77% deficient in microbiological training
46% of operators needing it - were deficient in chemical training (72%)

All these problems are compounded with the smaller systems. It may be impossible to adequately operate a small water system with the complex problems that now exist.

You might see now why our sample was these SMSAs. Really, none of these systems are 100 miles from nowhere. Most are all mixed in with larger supplies. If not interconnective of systems, some joint quality control, maintenance, training, and planning is needed.

As with all report writers, we have come up with recommendations.

1) Coliforms should be eliminated by source protection and disinfection.

2) Treatment technology should be applied to eliminate esthetic problems.

3) Distribution systems should be improved to prevent areas of low pressure.

4) Regionalization and merging of systems should be started.

5) Training programs should be enlarged.

6) State, county and local health department surveillance programs should be expanded.

7) A better method of indicating bacteriological safety in distribution systems should be developed and adopted for use.

8) More scientific data should be developed to support an updating of the Drinking Water Standards.

9) Technology should be improved to reduce nitrates, fluorides and organics where excessive.

10) Research should be conducted to determine the causes and means of preventing deterioration of water quality in distribution systems.

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